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In the Green Panopticon: Coproduction as Political Behavior

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Coproduction as Political Behavior[1]

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Abstract

From forest fires to terrorism, governments look to citizens to help monitor conditions and report threats, and so aid in the implementation of public policy. This paper casts such coproduction as a political act, arguing that political factors affect the level of citizen participation in policy implementation—especially when coproduction involves citizens monitoring others. Our empirical subject is water conservation in California communities during a severe drought, when the state ordered conservation and established a hotline and a website for citizens to report water waste anonymously. Over the course of the emergency, Californians reported more than 485,000 water waste complaints. We find that governance institutions and partisan conflict strongly predict complaint volume. We also find that complaints positively correlate with conservation outcomes. These results affirm that participatory surveillance can be a potent tool in policy implementation, but also that coproduction can be an extension of political conflict.

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Casting coproduction of public policy as a political act, this paper argues that governance institutions and partisan conflict affect the willingness of ordinary citizens to participate in the implementation of public policy. The concept of coproduction includes a variety of service processes in which lay citizens are directly involved in the design, delivery, monitoring, and evaluation of public policy alongside professional administrators (Whitaker 1980; Jo & Nabatchi 2016). Coproduction has received ample attention from scholars of public administration and public policy since its emergence as a concept. Of particular interest in the present study is the monitoring phase of policy implementation, where coproduction takes the form of *participatory surveillance*: citizens monitoring their fellow citizens' compliance with public policy.

In this paper we argue that coproduction is political: citizen involvement in the implementation of public policy is a costly expression of support for the policy, and means of participating in the exercise of government power. The political nature of coproduction is especially pronounced under participatory surveillance regimes: citizens who coproduce through participatory surveillance take part directly in the exercise of the state's coercive authority. As such, governance institutions and partisan conflict are expected to shape coproduction just as they do other forms of political participation, such as voting, protest, or campaign volunteering (Bartels 2000; Brady, Verba & Schlozman 1995; Jackman 1987). Public administration research on coproduction seldom engages with the idea of citizen participation in implementation as political behavior; coproduction has received hardly any attention in the vast and robust political science literature on political participation. We seek to connect these lines of research to understand better the antecedents and consequences of participatory surveillance in general, and with respect to environmental

policy in particular. Do politics drive participatory surveillance? Does participatory surveillance improve environmental policy outcomes?

Our empirical subject is water conservation in California communities during that state's 2014-2017 drought. In response to a severe water shortage, California's governor ordered utilities to reduce potable water consumption and introduced a series of statewide measures to promote conservation. As part of that effort, the state established a "tattle-tale" telephone hotline and an Internet portal for citizens to report water waste and violations of drought restrictions anonymously. That is, the state actively invited its citizens to participate in surveillance of their neighbors as a means of promoting water conservation. The people responded with gusto: over the course of the drought emergency (August 2014 - April 2017), Californians reported more than 485,000 water waste complaints.

The drought, hotline, Internet portal, and diversity of California's communities provide an extraordinary opportunity to explore participatory surveillance in a novel policy area. Most Californians receive drinking water utility service from a municipality, special district government, or private investor-owned company. Special district politics tend to receive less media attention and lower voter turnout than municipal governments, and private utilities are not subject to elections at all. Past research suggests that these differences in visibility and democratic engagement will drive more or less participation (Burns 1994; Mullin 2008). We also expect coproduction to reflect a community's political environment, since research on political participation suggests that coproduction should increase with local political competitiveness (Carlin & Love 2018; Michelitch 2015).

To preview our results, we find that, consistent with our expectations, political factors correlate strongly with participatory surveillance in California communities.

Municipal governments received water waste complaints more frequently than those served by special districts, and communities served by private, investor-owned water utilities made the fewest complaints on average. Moreover, participatory surveillance is positively correlated with party competitiveness: complaints about water waste were strongest in communities where partisanship is closely divided. Turning to outcomes, we find that complaints correlate positively with conservation, consistent with much of the public administration research on coproduction. Together these results indicate that political institutions and context can shape participatory surveillance, with important implications for environmental conservation and public policy more generally.

We begin with a discussion of citizen coproduction in public policy, with particular attention to participatory surveillance. Discussion then turns to the ways in which governance institutions and partisan conflicts affect citizen participation. Building on these lines of research, we argue that coproduction generally, and participatory surveillance specifically, are political acts. We then introduce the 2014-2017 California drought and the state's policy response to it. With the California drought as a test case, we lay out hypotheses about the politics of participatory surveillance. Empirical analysis of water waste complaints follows, yielding evidence consistent with our expectations about both institutions and partisanship. Turning from process to outcomes, we then analyze the relationship between participatory surveillance and conservation, finding that increased reporting correlates with greater conservation. We conclude with a discussion of the implications of our research for participatory surveillance as a means of promoting environmental conservation, and for citizen coproduction generally.

Coproduction and participatory surveillance

The idea of engaging citizens in the administration of public policy is as old as government itself, but the concept of coproduction entered the scholarly lexicon in 1970s and 1980s (Brudney & England 1983; Ostrom 1972; Ostrom & Ostrom 1977). In this line of research, *coproduction* is an umbrella term that captures a variety of service processes in which lay citizens are directly and voluntarily involved in the design, delivery, monitoring, implementation, and evaluation of public services with government employees (Whitaker 1980; Jo & Nabatchi 2016; Nabatchi, Sancino & Sicilia 2017). Generally lauded in the public administration literature, coproduction is widely accepted as an important means of providing public service and implementing public policy because it has both instrumental and normative values, such as reducing production costs, improving service quality, fostering innovation, increasing citizen satisfaction, and promoting democratic practices (Jakobsen, et al. 2016; Linders 2012).

Previous studies of coproduction have explored such varied policy areas as housing in England (Needham 2008), digital communities in the Netherlands (Meijer 2011), immigrant education in Denmark (Jakobsena & Andersen 2013), probation service in Estonia (Surva, Tõnurist & Lember 2016), immigrant services in Hong Kong (Tu 2016), neighborhood governance in Finland (Tuurnas 2016), and budgeting in Italy (Barbera, Sicilia & Steccolini 2016), among others. An exhaustive review of research on coproduction in public administration is beyond the scope of the present study (for excellent reviews of see Voorberg, Bekkers & Tummers 2015 and/or Nabatchi, Sancino & Sicilia 2017). Generally, research on coproduction has found that process design, financial resources, communication systems, professional skills, and social capital are important determinants

of coproduction (Van Damme, Caluwaerts & Brans 2016; Loeffler & Bovaird 2016).

Existing theoretical and empirical research treats coproduction as apolitical in the politics-administration dichotomy tradition (Wilson 1887). That is, coproduction is typically discussed in terms of administrative efficiencies and effectiveness. Political dimensions of coproduction have received comparatively little attention, as Voorberg, Bekkers & Tummers (2015) observe. Theoretical treatments of coproduction have tied coproduction to democracy insofar as government-public joint development and administration of public policies bolsters state legitimacy (Dahl 1960; Feller 1981). Left aside is the idea that a citizen's participation in coproduction might be a political act in itself. Active participation in the development and/or implementation of public policy is an implicit expression of support for that policy, or at least a tacit endorsement of government involvement in an area of public policy. That expression of support is all the more striking because it is costly for the individuals who coproduce, ostensibly for a collective public benefit.

If coproduction is political, how do governance institutions heighten or dampen coproduction? How do citizens' political preferences shape their willingness to coproduce? The answers to these questions are important because they point to incentives and constraints for politicians, managers, and citizens in the process of coproduction.

Methodologically, although the literature on coproduction is rich and varied, the bulk of existing coproduction research is descriptive and consists mostly of exploratory case studies, which limits causal inference, generalizability, and development of theories to explain variation in coproduction (Jo & Nabatchi 2016). Moreover, as Nabatchi, Sancino & Sicilia (2017) note, great deal of coproduction research carries a broad normative valence that presupposes coproduction's positive effects for governance. Systematic, quantitative,

and normatively objective investigations of coproduction remain relatively uncommon (but see Bifulco & Ladd 2006; Riccucci, Van Ryzin & Li 2016; Uzochukwu & Thomas 2018).

"If you see something, say something." Of particular interest in this study is citizen coproduction in the monitoring dimension of implementation, due to its clear political implications. Enforcement of any regulatory policy requires monitoring to ensure that regulated individuals or organizations comply. In many cases, governments actively seek participatory surveillance, inviting citizens to monitor others and report conditions violations to governments to expand the monitoring capacity of the state. Research in sociology, public health, and criminal justice explores conditions that affect citizens' willingness to report threats, crimes, and other violations to authorities (Brownstein, Freifeld & Madoff 2009; Crawford & Evans 2012; Lyon 2007; Reeves 2012).

Political scientists and public administration scholars have given surprisingly little attention to participatory surveillance, even as online social networks proliferate and governments encourage their citizens to report terrorist threats (Albrechtslund 2008). If the state is, as Weber (1968, p.56) argues, "the monopoly on the legitimate use of physical force in a given territory," then the willingness of people to report others for violating the law is a critical aspect of the relationship between citizen and state. In this sense, participatory surveillance is a profoundly political form of coproduction: citizens who monitor and report on others provide explicit support for both the ends and means of public policy, at their own cost (e.g., time, resources, skills, or civil liberty), and so participate in the exercise of governmental power. A political conception of coproduction invites consideration of participatory surveillance as a political act, subject to the same factors that shape other kinds of political participation.

Local political participation. Research on political participation has been a central pillar of political science since its emergence as a field. Electoral participation garners the greatest attention from political scientists (Cancela & Geys 2016; Downs 1957; Riker & Ordeshook 1968), but ample political science research examines participation beyond the ballot box, including participation in public meetings (Fung 2015), protests (Machado, Scartascini & Tommasi 2011), office-seeking (Fox & Lawless 2005), and other forms of political participation.

The bulk of coproduction research takes place in a local governance context, since the most proximate government in the day-to-day lives of most ordinary citizens is local. If coproduction is political behavior, local governance institutions might be expected to affect coproduction. In the United States, nearly 90,000 local governments provide basic services, and voluminous political science research investigates the ways in which variation in local institutions shape political processes, representation, and participation (Hughes 2012; Lubell, Feiock & De La Cruz 2009; Mullin 2008; Trounstine & Valdini 2008). General purpose municipal governments (cities, towns, and villages) are among the oldest local government institutions, and most familiar to most Americans. Beyond the services that they provide, local governments are channels through which citizens can participate in their own governance, and the institutions of local government can lead to more or less popular participation. Over the past century special purpose districts have proliferated and now outnumber municipalities in the United States (Jimenez & Hendrick 2010; Carruthers & Ulfarsson 2003).

With their regular elections and general scope of powers, municipalities are in most situations more visible than special district governments, and so garner greater media

attention, voter turnout, and citizen influence than special districts, where politics tend to be "quiet" (Burns 1994). As general purpose governments, municipalities also carry greater democratic legitimacy and capacity to facilitate and respond to citizen engagement (Mullin & Rubado 2017). Indeed, part of the rationale for the special district as a form of government is its relative insulation from democratic politics: many special district boards are appointed rather than elected, and their decision-making tends to be more professional than popular (Mullin 2009; Teodoro 2010).

Partisanship is an important driver of political participation (Chen 2013; Huddy, Mason & Aarøe 2015), and so might be expected to predict coproduction, too. Citizens' political preferences may shape their pursuit of policy information and how they interact with each other (Abramowitz & Saunders 2008; Jerit & Barabas 2012; Parker-Stephen 2013). Specifically, when partisan conflicts increase, political parties may invest more resources in mobilizing citizens' political participation and citizens may also have greater general interest in politics and public policy (Arce & Mangonnet 2013; Patterson & Caldeira 1983; Rainey 2015). By the same logic, the intensity of partisan conflicts might be expected to correlate with coproduction.

Coproduction as political behavior

Here we adapt a classic model of coproduction to account for political variables that might condition citizen participation in the production of public services. The process of coproduction includes inputs and outputs. The outputs of coproduction are public service, such as public safety, education, or a clean environment. What distinguishes coproduction from other parts of the public policy process is its inputs. Coproduction activities require

the inputs of both governments and citizens. The inputs of governments normally include financial investment and personnel costs, whereas citizens' inputs include time, resources, skills, and sometimes civil liberties (Ferris 1984).

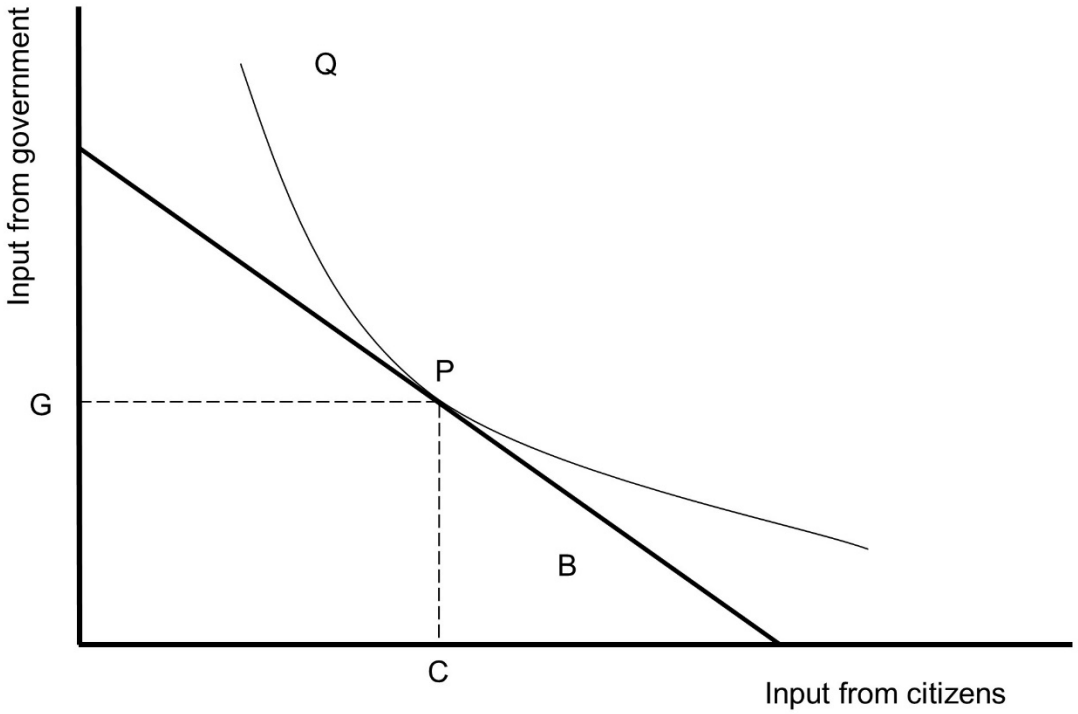

Figure 1. Simple coproduction

Contributions from government and citizens to public service output under coproduction tend to be at least partially complementary rather than purely substitutable (Parks, et al. 1981). Figure 1 shows an adaptation of the coproduction function in Parks, et al. (1981) and Ostrom (1996). In Figure 1, isoquant *Q* represents production for various combinations of inputs from government and citizens. *B* represents the budget function and its slope is determined by the ratio of the wage rate of regular provider (e.g., water utility) employees to the opportunity cost of citizens. Given this typical complementary

relationship, at the tangency point P_1, coproduction is technically achievable, economically desirable, and likely to generate the benefits observed in public administration research on the subject. Citizens will provide inputs at *C* and institutional providers at *G.*

Nevertheless, as Parks et al (1981) note, contextual factors may still constrain coproduction by limiting the use of citizen inputs. Coproduction is always costly to the citizen, but occurs because (s)he gains some benefit from providing input. When coproduction is understood as a political act, it follows that political variables can influence the wages and opportunity cost ratio and facilitate or inhibit citizen inputs. Political considerations may inhibit coproduction by raising the cost of participation or encourage more coproduction by generating additional benefits to the coproducing citizen. In the case of participatory surveillance, citizens' constraints may be determined by organizational visibility and capacity, while their motivations can be affected by the intensity of partisan conflict. Here we advance a simple theory of institutions and participatory surveillance based on organizational visibility and capacity for citizen engagement.

Institutions. The visibility of the organizations charged with implementation of public policy is expected to affect coproduction. Visibility can affect coproduction both directly and indirectly. Most obviously, citizens are more likely to participate in the implementation of public policy if they are familiar with the organizations that administer those policies and perceive them to be responsive to public input. Such familiarity is particularly important for participatory surveillance, which relies upon citizen-initiated contacts (Jones, et al. 1977; Serra 1995): where service providers are well-known, citizens may more easily report potential violations. If the visibility of a service provider among citizens is low, citizens who otherwise might participate in surveillance might not know

how to contact agencies or firms.

Less obviously but no less importantly, the visibility of a service provider can affect coproduction indirectly by shaping citizens' attitudes about coproduction. Citizens may feel empowered to participate in policy implementation when services are provided by familiar, high-profile governments. When services are provided by more obscure special districts, citizens are less likely to identify with the agency, and so are less likely to engage with policy implementation. When services are provided by private firms, citizens may perceive implementation to be a private matter and coproduction to be inappropriate.

Institutions also vary in their capacity to engage with citizens politically. Where high-profile municipal governments are responsible for providing a public service in a community, local politicians have electoral incentives to invest time and resources in publicizing their services and inviting citizens to engage in the policy process. As general purpose governments, municipalities often invite coproduction across multiple services through advisory committees, public meetings, and community events (Nabatchi, Sicilia & Sancino 2017), for example. Aside from their direct benefits for implementation, investment in this kind of coproductive capacity helps politicians build legitimacy (Dahl 1961), whether or not the citizen engagement actually improves the quality or efficiency of public services.

With their narrower missions and usually less-contested elections, special district governing boards have fewer incentives to invest in such coproductive capacity. Consequently, special districts are expected to engage their citizens in the policy process less frequently than do municipal governments (Mullin & Rubado 2017). Privatization of a public function shifts the government's role from producer to regulator and inhibits citizen participation even further. Firm managers are responsible to their shareholders and

regulators, and have little or no incentive or capacity to facilitate citizen participation in policy implementation (Morgan & England 1988; Haque 1996; Warner & Hefetz 2002).

Institutions and participatory surveillance. These observations about visibility and coproductive capacity suggest ways in which politics can influence the ratio of the wage rate of provider to the opportunity cost of citizens and so change the mix of inputs under coproduction.

Under general purpose municipal governments, citizens have the lowest opportunity costs for coproduction because they are already familiar with these highly visible institutions. Where special districts provide service, their lower visibility and coproductive capacity raise the opportunity cost of citizen participation. The low visibility and coproductive capacity of private service providers leads to even higher opportunity costs for citizens to engage in coproduction. This analysis leads us to predict a simple ordered relationship between political/administrative institutions and participatory surveillance in local government: *participatory surveillance is most frequent under municipal governments, less frequent under special district governance, and least frequent under private organizations.*

Partisan conflict and participatory surveillance. The intensity of partisan conflict shapes citizens' political behaviors. Previous empirical evidence shows that hostile feelings for the opposing party can affect people's judgments and behaviors and make them display open animus for opposing partisans (Iyengar & Westwood 2015). Citizens in communities with more neighbors with opposing political views are more likely to engage in political

activities (Perez-Truglia & Cruces 2017).[2] When a community is politically competitive, parties or activists have an incentive to invest resources in mobilizing citizens to confront rather than cooperate with each other (Muddiman & Stroud 2017; Rainey 2015). When public service providers offer the opportunity for citizens to report neighbors for regulatory violations, citizens may have greater direct motivation to surveil and file complaints against their neighbors in politically contentious communities. Heightened party competition can drive participatory surveillance directly if partisans see coproduction as a venue of conflict with their partisan opponents. Indirectly, party competition might increase participatory surveillance if competitiveness raises overall political engagement. The raised political stakes in politically competitive communities means citizens may generally value political participation more than citizens in non-competitive areas, increasing the perceived benefits from coproduction. Thus, party competition can cause greater levels of coproduction even when local governments are formally nonpartisan, issues are not overtly ideological, and party leaders are not specifically focused on the policy being coproduced. Taken together, we predict that *as partisan conflict increases, participatory surveillance also increases*.

Finally, following most prior research on coproduction, we expect citizen engagement to improve policy results. Thus, *as citizen participatory surveillance increases, policy outcomes also improve.*

With these expectations in mind, we turn to an exceptionally useful case for testing the relationship between governance institutions and participatory surveillance: California water utilities and their responses to that state's severe drought in 2014-2017.

[2] Although citizens prefer living in more politically compatible communities, they tend to forgo this intention in real life due to common socio-economic concerns (Mummolo & Nall 2017).

In the Green Panopticon: Participatory surveillance and the California drought

California's recent experience with drought provides an extraordinary opportunity to examine participatory surveillance in the implementation of environmental policy. California began experiencing long-term drought conditions in 2007, when the seasonal mountain snow that many of the state's cities rely upon for drinking water was unusually low. By 2013, the drought reached crisis conditions as the snowpack was just 17 percent of normal levels. In response, in January 2014 California Governor Jerry Brown issued a statewide Water Action Plan that called for sweeping reforms to water consumption and management across all levels of government.[3] The drought continued to intensify, however; tree ring data indicate that 2012-2014 was the most severe drought in California for the past 1,200 years (Griffin & Anchukaitis 2014). By early 2015 California's mountain snowpack was effectively gone, leaving the state desperately short of water for urban supply.

The State Water Resources Control Board (SWRCB) holds legal authority over all local retail, wholesale, and agriculture water resources in California. In June 2014 the SWRCB issued a series of orders to curtail water use in urban areas, including mandatory conservation rules for 408 of the state's retail water utilities. Much of California's residential water demand is driven by discretionary outdoor use (e.g., lawn watering and car washing), rather than by essential indoor use (e.g., drinking, cooking, flushing toilets). Accordingly, in July 2014 the SWRCB approved a statewide emergency regulation that mandated fines of up to $500 a day for residents who waste water on such activities. For example, the SWRCB regulation prohibited washing down driveways and sidewalks, watering of outdoor landscapes that cause excess runoff, using a hose to wash a motor

[3]The California Water Action Plan: http://resources.ca.gov/california_water_action_plan/

vehicle (unless the hose is fitted with a shut-off nozzle), and using potable water in a fountain or decorative water feature, unless the water is recirculated.[4]

The state also established an online portal and telephone hotline to allow anonymous reporting of water waste violations. The state website invited participants to identify specific locations of water waste and submit photographs documenting the violation. Figure 2 shows the reporting site at savewater.ca.gov.[5] In effect, California established a high-profile regulatory regime for water conservation, with participatory surveillance as an explicit element of its implementation.

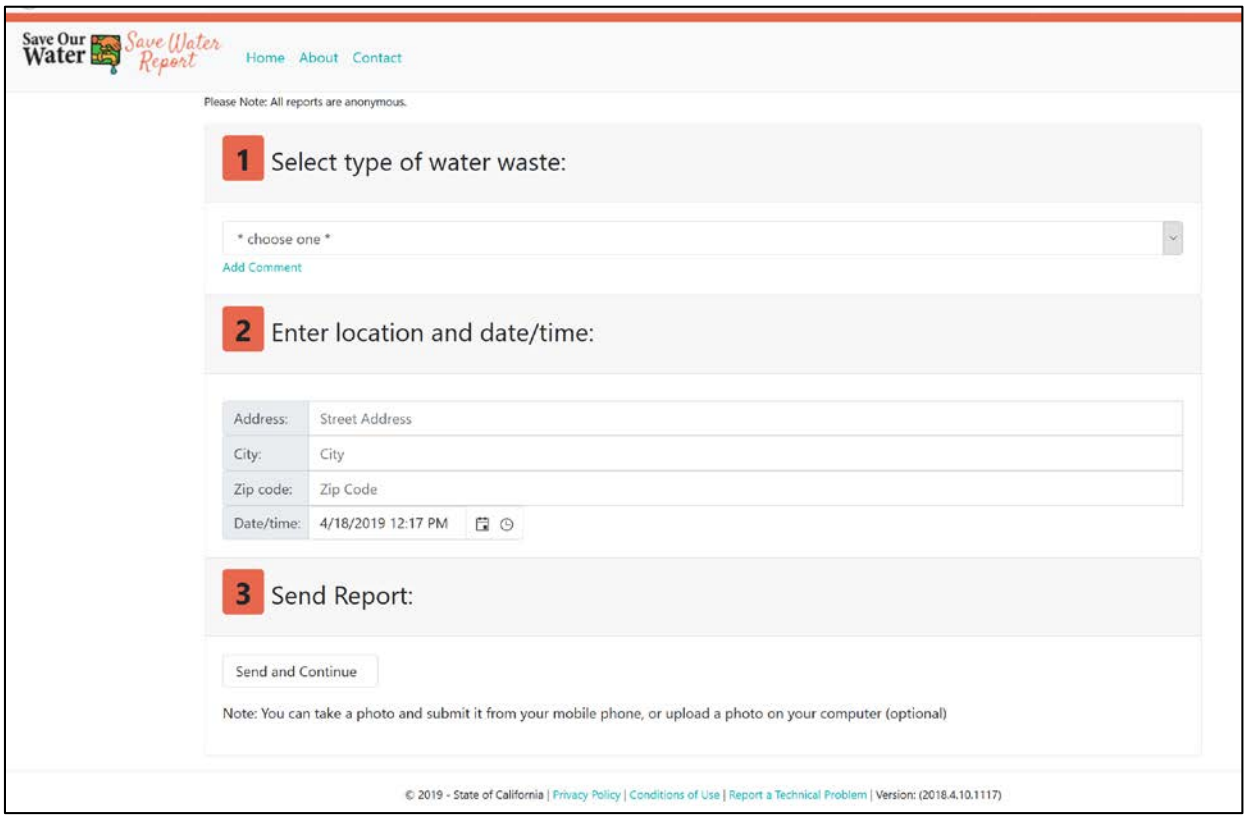

Figure 2. California water waste reporting website

[4] State Water Board Approves Emergency Regulation to Ensure Agencies and State Residents Increase Water Conservation
http://www.swrcb.ca.gov/press_room/press_releases/2014/pr071514.pdf
[5] Save Our Water http://savewater.ca.gov/

To track progress, the SWRCB required water utilities to record and report a variety of water use data, including the number of water waste complaints received online or through telephone calls. Additionally, utilities patrolled their service areas directly by sending staff to residential communities in search of water waste. After receiving complaints or observing violations, utilities proceeded with a series of escalating enforcement steps. The first enforcement step was a "follow-up action," an informal intervention that typically involved investigating a reported violation and then sharing information with the violator with a goal of inducing compliance through education. The second step of enforcement was the issuance of a formal warning, where the utility documented the violation and informs the violator of the SWRCB regulations and its threat of $500 daily penalties. The final step was the issuance of a formal penalty and fine.

The utilities that were subject to the state conservation mandate varied considerably in water use, drought conditions, service population, community demographics, and other economic indicators. Crucially for present purposes, the 408 California utilities also varied in their institutional arrangements: 202 are agencies of municipal or county governments, 144 are special districts, and 62 are private, investor-owned firms. The investor-owned utilities provide a useful comparative category for present purposes, since these private organizations are not formally responsible to voters and so are not clear venues for democratic participation (Hefetz & Warner 2011; Teodoro, Zhang & Switzer 2018). Our first hypothesis about participatory surveillance during the California drought follows from our general expectations about the relationships between institutions and political participation:

H1 Political institutions: citizen reports of drought violations are most frequent for municipal utilities, less frequent for special district utilities, and least frequent for

private utilities.

Partisanship also varied significantly across the drought-stricken California communities. The share of registered Democratic Party members in total registered partisans in 2016 ranges from 24% to 93% among the utilities analyzed here, offering a wide range of partisan competitiveness. Our second hypothesis relates partisan conflict to coproduction as political behavior:

H2 Partisan competitiveness: citizen reports of drought violations increase as partisan competitiveness increases.

As discussed earlier, the effects of party competition may be indirect; a politically competitive community may support a more engaged citizenry, even if parties do not explicitly mobilize citizens in a coproduction effort. Indeed, all California local governments are formally nonpartisan under the state's Constitution. Thus any effect of party competition on participatory surveillance in the present case is probably indirect. The implied null hypothesis is that coproduction is apolitical, and so does not relate significantly to either political institutions or partisanship.

Data and Methodology

We evaluate these hypotheses using data from the SWRCB's Monthly Reporting Archive[6] and its monthly observations of 408 water utilities in California during the state's drought emergency period: August 2014 through April 2017. These utilities provide urban water supplies, and so our analysis does not include agricultural water regulations or

[6] California State Water Board's Monthly Reporting Archive http://www.waterboards.ca.gov/water_issues/programs/conservation_portal/conservation_reporting.shtml

demands. We merge these data with system information from the Environmental Protection Agency's Safe Drinking Water Information System (SDWIS) in 2014 and community information from the U.S. Census' 2015 American Community Survey's five-year estimates (ACS), and 2016 voter registration data from the California Statewide Database.

Estimating participatory surveillance. We measure participatory surveillance as the number of complaints received per thousand population served by each utility in each month. Utilities received an average of .38 drought complaints per month per thousand people, although the rate of reporting varied considerably across communities and over time. We use ordinary least square regression to estimate this dependent variable; our unit of analysis is the utility-month, and standard errors are clustered by utility.

Political variables. For the political institutions hypothesis (H1), the key independent variables are dummies: *municipal government* equals 1 if the water utility is operated by a general purpose municipal government (zero otherwise), and *special district* is coded 1 if the water utility is operated by a special district (zero otherwise).[7] Private, investor-owned utilities serve as the reference category.

To test the partisan competitiveness hypothesis, the level of *party competition* in each service area is measured as one minus the difference between registered Democrats and Republicans divided by total registered Democrats and Republicans.[8] Mathematically, this measure is:

[7] Two of the utilities in our dataset are operated by county governments. These are coded as *municipal* utilities because they are general purpose local governments led by elected legislative councils.
[8] We use registered partisanship rather than partisan electoral results because registration is expected to be more stable than election results in any given election, which may fluctuate with due to context-specific issues or candidates.

$$1 - \left| \frac{Registered\ Democrats - Registered\ Republicans}{Total\ Registered\ in\ a\ Major\ Party} \right|.$$

A higher value indicates more intense party competition. For instance, if a service area were entirely dominated by one party (i.e., a single party enjoys 100 percent of major party registrations), then the value of the party competition index would be zero. If a service area was exactly evenly divided between Democratic- and Republican-registered voters (50% Democrats and 50% Republicans), the value of this party competition index would be one. Partisanship was measured for each utility by aggregating precinct-level party registration data. We drew data on party registration from the California Statewide Database, which contains information on voting and registration for statewide elections in California since 1992.[9] We aggregated the number of individuals registered as Republicans and Democrats in the 2016 general election for each voting precinct overlapping utilities' service areas to develop a measure of major party registration share for each utility. Utility boundary data were drawn from the California Environmental Health Tracking Program, which contains current service areas for all the utilities in our dataset.[10]

Importantly, party competition as measured by registrations positively and significantly correlates with voter turnout in the present sample. Figure 3 shows the relationship between 2016 general election turnout across the 408 California communities served by the utilities analyzed here across the range of party competitiveness.[11] This positive correlation suggests a generally heightened level of political participation in

[9] University of California. 2018. California Statewide Database. Retrieved from http://statewidedatabase.org/index.html.
[10] California Environmental Health Tracking Program. 2018. Water System Service Areas. Retrieved from https://trackingcalifornia.org/water-systems/water-systems-landing.
[11] The positive relationship between party competition and voter turnout holds in fully-specified regression models reported in Table A1 in the appendix.

communities where party competition is stronger.

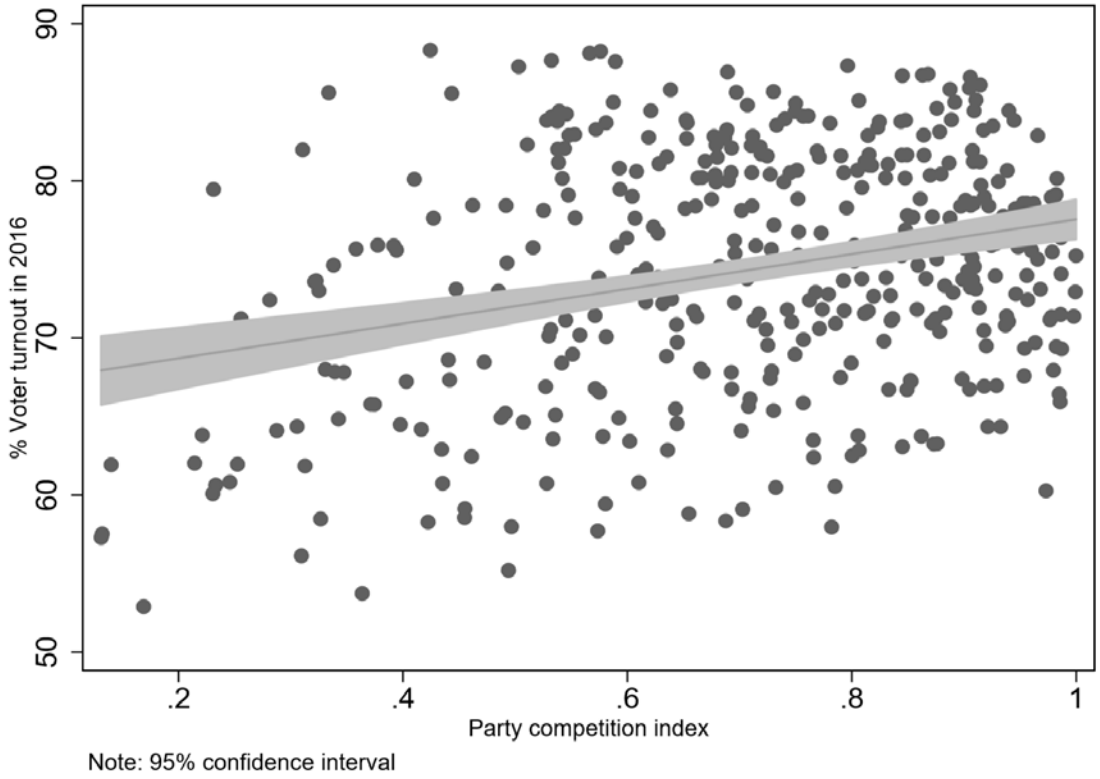

Figure 3. 2016 Voter turnout by party competition

Controls. Our estimates include several variables to control for utility characteristics. First, we control for each utility's conservation potential by including the utility-level *conservation target* set by the SWRCB in 2015 in the models. In May 2015, the SWRCB adopted an emergency regulation to implement a mandatory 25 percent statewide reduction in potable urban water use between June 2015 and February 2016.[12] To achieve the reduction, the emergency regulation assigned each urban water supplier to one of nine tiers based on their residential gallons per capita per day (R-GPCD) for the months of July – September 2014. Each tier of utilities was then assigned a conservation standard that ranged

[12] SWRCB RESOLUTION NO. 2015-0032
https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2015/rs2015_0013.pdf

between 4 percent and 36 percent, with higher historical R-GPCD utilities receiving higher conservation standards. In setting varying standards, the SWRCB recognized that water systems vary considerably in pre-drought water use patterns: communities that were already relatively conservative in water demand have relatively little room for additional conservation, while high-demand communities have much greater potential for conservation. A higher conservation target mandated by the state indicates more conservation potential.

Communities also varied in the degree to which they regulated water use, and so we control for the strength of local water restriction*s* (measured as outdoor irrigation *days allowed per week*). To account for differences in the type of customers served in each community, we control for the percentage of water demand from residential (as opposed to commercial or industrial) customers. We account for the water source of a utility by setting two variables: a dummy equal to one if a utility relies on *groundwater* and zero otherwise; a dummy equal to one if a utility purchases water from a *wholesale* supplier, and zero otherwise. California covers a large and varied geographic area, with considerable variation in moisture and drought conditions across the state. Since local drought conditions might affect participatory surveillance, we control for drought severity with data from the National Drought Mitigation Center at the University of Nebraska-Lincoln. Their weekly *drought score* measures drought conditions on a 6–point scale ranging from normal conditions to exceptional drought. We then aggregate the weekly measure into an average monthly measure. For the weeks that overlapped months, we weight them according to the number of days in each month.

Demographic and economic characteristics of communities can also potentially

influence coproduction and conservation. To account for their effects, we first include the percent of *voter turnout* in 2016 presidential election to isolate the effects of main political variables of interest, aggregating precinct-level turnout data the same way we aggregated registrations. We include the mean-to-median ratio of residents' income in the models to control for economic inequality. We control for *population density* (1,000 population per square mile), since more densely-concentrated populations might increase the likelihood that incidents of water waste are observed by others.

Racial/ethnic *diversity* is calculated using $1 - \sum_{i=1}^{n} p_i^2$ (i.e., the Gibbs-Martin or Blau index), where p_i represents a share of an ethnicity i in a population. We also include the percentages of black, Hispanic, and Asian population, the percentage of adults with a bachelor's degree, as well as the percentage of the population with incomes below the poverty level, in the communities served by the utilities. Lower overall rates of political participation among poor and nonwhite populations suggest that coproduction might also be lower among these same populations. Similarly, we expect *median household income* to correlate positively with violations of water restrictions because more affluent homes tend to feature larger irrigated areas and swimming pools. We use the monthly *Google Trends*' search volume index on the topic "Drought" in California to control for the salience of drought issues among California residents (Kam, Stowers & Kim 2019; Quesnel & Ajami 2017), which we expect to positively predict water waste complaints.

A descriptive summary of all variables is provided in Table 1.[13] The demographic variables are fixed for each utility over the period of analysis, and so act as community

[13] A small number of missing observations are missing due to the loss of some utilities' information in the SWRCB's Monthly Reporting Archive in scattered months.

fixed effects for purposes of the present analysis. We also summarize descriptive statistics separately for municipal, special district, and private utilities in the appendix.

Table 1 Summary Statistics (August 2014-April 2017)

Variable	Obs	Mean	Std. Dev.	Min	Max
Complaints per 1,000 population	13,393	0.38	1.19	0.00	47.29
% Monthly potable water conservation compared to 2013	13,393	19.41	13.32	-108.42	79.23
Municipality	13,393	0.49	0.50	0.00	1.00
Special district	13,393	0.35	0.48	0.00	1.00
Party competition	13,393	0.71	0.20	0.13	1.00
% State conservation standard	13,393	24.54	8.51	4.00	36.00
Water days allowed per week	13,393	3.91	2.26	0.00	7.00
% Residential use	13,393	69.87	15.39	0.05	100.00
Groundwater	13,393	0.34	0.47	0.00	1.00
Purchased water	13,393	0.43	0.50	0.00	1.00
Drought score	13,393	3.92	1.47	0.00	5.00
Percent turnout	13,393	74.31	7.68	52.90	88.32
Mean-median income ratio	13,393	1.29	0.11	1.05	2.08
Population density	13,393	6.80	23.59	0.00	423.47
Ethnic diversity	13,393	0.53	0.14	0.05	0.78
% Hispanic	13,393	41.35	23.54	4.55	97.49
% Black	13,393	4.15	5.19	0.00	43.59
% Asian	13,393	11.61	12.74	0.10	67.13
% Bachelor degree	13,393	29.21	16.16	1.86	79.90
% income below poverty	13,393	15.08	7.51	2.40	41.30
Median household income ($1000)	13,393	67.17	24.27	23.06	229.10
Monthly Google trend	13,393	41.51	19.48	20.00	100.00

Results

Table 2 presents our analysis of participatory surveillance with three OLS regressions: the first (Model A) includes only the utility characteristics and community demographic controls; the second (Model B) adds the key independent variables of interest here: *municipal, special district*, and *party competition*. Inclusion of these variables markedly improves overall model fit (ΔR^2 0.07, ΔAIC -108.77, ΔBIC -86.26), consistent with the general idea of coproduction as political behavior. Since the distribution of participatory surveillance is highly skewed, a third model (Model C) excluding the top 1% outliers (i.e., Dependent Variable>5.0) is included in Table 2 to bolster the robustness of the estimated relationships.

Our results provide evidence consistent with the hypothesized ordered relationship between governance institutions and complaints lodged with water utilities. As Model B shows, all else equal, citizens reported more complaints to special district utilities than to private utilities (the reference category), and even more complaints to municipal utilities. In substantive terms, these differences indicate that, all else equal, special districts received 0.09 more and municipal utilities 0.24 more drought violation reports per thousand persons relative to private utilities. A Wald test suggests that the +0.13 difference between municipal utilities and special districts is statistically significant (F=5.81, p=0.02). Turning to party competition, our results show that a one standard deviation increase in party competition is associated with a 0.06 (or 15.8 percent) increase in drought violation reports per thousand population. Model C shows that the coefficients are slightly smaller but more precisely estimated when the outliers are dropped from the regression. Overall, these results affirm our political institutions (H1) and party competition (H2) hypotheses.

Table 2. Determinants of complaints per 1000 population, August 2014-April 2017

	Model A		Model B		Model C (Drop DV>5, top 1%)	
	Coefficient (Robust SE)	p	Coefficient (Robust SE)	p	Coefficient (Robust SE)	p
Municipality			0.242	0.000	0.178	0.000
			(0.05)		(0.03)	
Special district			0.093	0.106	0.062	0.083
			(0.06)		(0.04)	
Party competition			0.318	0.098	0.158	0.040
			(0.19)		(0.08)	
% State conservation standard	0.022	0.000	0.019	0.000	0.013	0.000
	(0.00)		(0.00)		(0.00)	
Water days allowed per week	-0.047	0.000	-0.047	0.000	-0.027	0.000
	(0.01)		(0.01)		(0.01)	
% Residential use	-0.004	0.014	-0.003	0.069	-0.001	0.093
	(0.00)		(0.00)		(0.00)	
Groundwater	-0.073	0.468	-0.088	0.400	-0.042	0.314
	(0.10)		(0.10)		(0.04)	
Purchased water	-0.109	0.183	-0.137	0.122	-0.079	0.044
	(0.08)		(0.09)		(0.04)	
Drought score	0.036	0.135	0.029	0.225	0.044	0.000
	(0.02)		(0.02)		(0.01)	
Percent turnout	0.002	0.625	-0.001	0.854	0.000	0.990
	(0.00)		(0.01)		(0.00)	
Mean-median income ratio	0.393	0.209	0.258	0.435	-0.012	0.943
	(0.31)		(0.33)		(0.17)	
Population density	0.001	0.411	0.001	0.457	0.000	0.457
	(0.00)		(0.00)		(0.00)	
Ethnic diversity	0.049	0.819	-0.101	0.625	-0.066	0.559
	(0.22)		(0.21)		(0.11)	
% Hispanic	0.000	0.647	0.000	0.828	0.000	0.647
	(0.00)		(0.00)		(0.00)	
% Black	-0.004	0.201	-0.001	0.758	-0.001	0.747
	(0.00)		(0.00)		(0.00)	
% Asian	0.000	0.922	0.001	0.761	0.001	0.590
	(0.00)		(0.00)		(0.00)	
% Bachelor degree	0.003	0.163	0.004	0.106	0.005	0.007
	(0.00)		(0.00)		(0.00)	
% Income below poverty	-0.000	0.973	-0.001	0.934	0.002	0.573
	(0.01)		(0.01)		(0.00)	
Median household income (1000s)	-0.002	0.244	-0.002	0.420	-0.002	0.199
	(0.00)		(0.00)		(0.00)	
Monthly Google trend	-0.004	0.130	-0.003	0.203	-0.005	0.000
	(0.00)		(0.00)		(0.00)	
Constant	-0.424	0.521	-0.340	0.596	-0.078	0.820
	(0.66)		(0.64)		(0.34)	
Observations	13393		13393		13247	
R-squared	0.130		0.137		0.238	
AIC	40829.346		40720.576		20772.511	
BIC	41196.968		41110.705		21162.070	

Note: Dependent variable is the number of complaints per 1000 received by each utility each month. Robust standard errors clustered by utilities in parentheses. Models also include month dummies. Two-tailed p-values reported.

The control variables yield some notable results too. As expected, conservation potential and outdoor watering restrictions (i.e., the reverse of water days allowed per week) strongly predict complaints. However, we find a negative relationship between percentage of residential usage and complaints, which suggests that complaints are more likely in places with more commercial and industrial water use. Utilities with purchased water receive fewer complaints than utilities with utilities provide their own source water. Drought severity has a slightly positive impact on citizen complaints. We do not find strong evidence to support the direct impact of groundwater, voter turnout, income inequality, population density, ethnicity, race, or socioeconomic indicators on participatory surveillance.

Estimating outcomes: water conservation. Is increased participatory surveillance associated with improved policy outcomes in the ways predicted by canonical coproduction models? To examine the relationship between coproduction and outcomes in the case of the California drought, we analyzed the correlation between participatory surveillance and utilities' overall water conservation. The dependent variable in this second analysis is the monthly percentage water conservation compared to the same month in 2013. This measure of conservation for utility i in month m of year y is calculated as:

$$Water\ Conservation_{i,y,m} = \frac{Production_{i,m,2013} - Production_{i,m,y}}{Production_{i,m,2013}}$$

Notably, this is the official conservation metric that the SWRCB adopted at the onset of drought emergency order.

Given the dynamic nature of the dependent and independent variables, we employ the Arellano-Bond dynamic estimation procedure to use current and past information to

estimate utility water conservation. This generalized method of moments (GMM) approach uses first differencing to remove the unobserved panel-level effects and use instruments (e.g., the lagged dependent variable and endogenous variables) to create moment conditions (Arellano and Bond 1991). A test for the serial correlation structure rejects no autocorrelation of order 1 (z=-11.28) and cannot reject no autocorrelation of order 2 (z=-0.41). Accordingly, there is evidence that the Arellano-Bond model assumptions are satisfied. The time-invariant variables are automatically dropped from the model, and the analysis yields estimates of within-unit variation over time.

Table 3. Does coproduction correlate with conservation? (GMM Model)

	Model D Coefficient (Robust SE)	p
Complaint per1000	0.555 (0.25)	0.026
Water days allowed per week	-1.868 (0.10)	0.000
% Residential use	0.073 (0.03)	0.032
Monthly Google trend	0.089 (0.01)	0.000
Drought score	-0.974 (0.09)	0.000
L.% Monthly potable water conservation compared to 2013	0.338 (0.02)	0.000
Constant	15.152 (2.52)	0.000
Observations	13329	
Chi-squared	1998.118	

Note: Dependent variable is each utility's monthly percentage water conservation compared to the same month in 2013. Robust standard errors clustered by utilities in parentheses. Two-tailed p-values reported.

Table 3 reports the resulting estimates of overall utility conservation. As Model D shows, complaints significantly and positively correlate with water conservation.

Substantively, one more complaint per thousand persons predicts a 0.56 percent increase in monthly water conservation. Although this effect is small in percentage terms, it translates into a significant volume of water in a state as large as California. Summed across the utilities analyzed here, one more complaint per thousand persons would have resulted in 32 billion of gallons of additional water saved over the period of analysis: enough to supply the City of San Francisco for 16 months. It would be inappropriate to infer from this analysis that Californians' participatory surveillance *caused* the observed conservation outcomes. However, our results are broadly consistent with previous findings that citizen coproduction has a positive impact on policy outcomes (Nabatchi, Sicilia & Sancino 2017).

The estimated coefficients of the time-varying control variables yield other interesting findings, as well. As expected, when there are more water days allowed per week (i.e., weaker outdoor watering restrictions), utilities tend to conserve less water. The percentage of residential use is positively associated with water conservation, which suggests that the residential communities are more responsive to the state conservation policy than the industrial or agricultural communities. The salience of the drought measured by monthly Google trend positively predicts water conservation, consistent with other studies of media salience and water conservation (Quesnel & Ajami 2017). Finally, the severity of drought conditions is negatively associated with water conservation, which is counter-intuitive and deserves deeper examination with more information.

Discussion

Governments that seek coproduction in the monitoring phase of policy implementation invite citizens to serve as conduits of information about compliance to the

agencies responsible for enforcement. Whether citizens answer the call to monitor their neighbors is a fundamentally political matter; it follows that political institutions and partisan conflicts are likely to shape coproduction. In theorizing about politics and coproduction, we posited that governance institutions vary in visibility and coproductive capacity, and that this variation predicts differences in participatory surveillance. We also argued that the increased political participation caused by party competition would simultaneously drive increased coproduction.

To test these arguments, we analyzed California utilities' experience with participatory surveillance in the implementation of water regulations during a drought emergency. Comparing municipal, special district, and private utilities, we found that citizens reported violations most frequently under municipal governments, less frequently under special districts, and least under private utilities. We also found that water waste complaints increase as party competition in a community increases. Further analysis shows that participatory surveillance correlates with water conservation, consistent with most prior research on coproduction in public administration.

Scholars and proponents of coproduction give significant attention to the ways that citizen engagement in the administration of public policy can affect performance and efficiency, as well as its implications for democratic governance. Our focus on the monitoring dimension of coproduction—participatory surveillance in which citizens are asked to monitor and report on each other—accentuates the political aspect of citizen participation in policy implementation. As a political act, coproduction is as much a function of political institutions and behaviors as it is a matter of efficient and effective administration.

Limits and directions for future inquiry. Notably, the empirical inferences in this work are limited by their reliance on aggregated utility-level data. In this way, our analysis of coproduction through participatory surveillance is similar to canonical cross-national comparative political analyses of institutions and party effects on voter turnout (Powell 1986; Jackman 1987; Baek 2009). Verifying the specific direct and indirect mechanisms that link political institutions or party competition to citizen participatory surveillance or water conservation requires data on individual behavior. Future research with fine-grained data should further examine the direct and indirect ways in which political variables drive or condition individual coproduction decisions. Such an approach holds out considerable potential for students of both public administration and political behavior.

Conclusion. Our research demonstrates that politics generally deserves more attention in coproduction research. For scholars and proponents of coproduction, the implication is that governance institutions and party competition can encourage or discourage citizen engagement in policy implementation, just as they can encourage or discourage other forms of political participation. It is worth observing, however, that a policy of coproduction through participatory surveillance shapes, subtly or boldly, the relationship between citizens and the state, as well as citizens' relationships with each other. A government that encourages its citizens actively to monitor each other opens new paths for implementation, but also new conduits for conflict.

Practically, this study demonstrates that calls for participatory surveillance can be effective: California's government asked citizens to monitor and report on each other's environmental behavior, and Californians responded with nearly a half-million reports of water waste over the course of the drought, with apparently positive conservation results.

Policymakers might expand participatory surveillance to more areas of environmental policy areas, such as energy, forest conservation, or greenhouse gas emissions. Participatory surveillance perhaps holds out similar promise in other areas of public policy, from labor to housing to immigration to drugs. Whether the promise of participatory surveillance as an instrument of implementation justifies its possible political side-effects is a more fundamental question beyond the scope of this work.

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Appendix

Table A1. Partisan competition and voter turnout, November 2016

OLS regression	Coefficient (Robust SE)	p
Party competition	10.238	0.000
	(1.53)	
% State conservation standard	-0.047	0.198
	(0.04)	
Water days allowed per week	-0.135	0.276
	(0.12)	
% Residential use	-0.008	0.657
	(0.02)	
Groundwater	-1.208	0.091
	(0.71)	
Purchased water	-1.903	0.006
	(0.69)	
Drought score	-1.456	0.000
	(0.20)	
Mean-median income ratio	0.834	0.756
	(2.68)	
Population density	-0.023	0.037
	(0.01)	
Ethnic diversity	-7.396	0.000
	(2.00)	
% Hispanic	-0.035	0.006
	(0.01)	
% Black	-0.116	0.023
	(0.05)	
% Asian	-0.070	0.002
	(0.02)	
% Bachelor degree	0.125	0.000
	(0.03)	
% Income below poverty	-0.466	0.000
	(0.06)	
Median household income ($1000)	-0.021	0.393
	(0.02)	
Constant	86.307	0.000
	(4.60)	
Observations	406	
R-squared	0.595	
AIC	2473.551	
BIC	2541.659	

Note: Dependent variable is percentage turnout for the November 2016 general election in 406 California communities. Turnout is aggregated from precinct-level data and matched to utility service areas. This model shows the statistically and substantively significant relationship between partisan competition and electoral participation. Two-tailed p-values reported.

Table A2. Descriptive Statistics for Municipal Utilities (Aug 2014-Apr 2017)

Variable	Obs	Mean	Std. Dev.	Min	Max
Complaint per1000	6,617	0.46	1.21	0.00	16.41
%Monthly water conservation compared to 2013	6,617	18.74	12.97	-89.26	66.51
Municipal	6,617	1.00	0.00	1.00	1.00
Special district	6,617	0.00	0.00	0.00	0.00
Party competition (registered)	6,617	0.69	0.22	0.13	1.00
% State conservation standard	6,617	23.78	8.24	4.00	36.00
Water days allowed per week	6,617	3.83	2.28	0.00	7.00
% Residential use	6,617	67.01	14.13	0.05	100.00
Groundwater	6,617	0.36	0.48	0.00	1.00
Purchased water	6,617	0.43	0.50	0.00	1.00
Drought score	6,617	3.93	1.49	0.00	5.00
Percent turnout	6,617	73.16	7.42	55.21	88.26
Mean-median ratio	6,617	1.31	0.13	1.05	2.08
Population density	6,617	8.80	32.67	0.03	423.47
Ethnic diversity	6,617	0.53	0.15	0.05	0.78
Percent Hispanic	6,617	41.86	24.06	4.55	97.49
Percent Black	6,617	4.24	5.20	0.00	41.94
Percent Asian	6,617	11.67	13.21	0.10	67.13
Percent bachelor	6,617	27.28	16.75	2.70	79.90
Percent poverty	6,617	16.48	7.94	2.40	41.30
Median household income ($1000)	6,617	63.12	24.02	27.62	229.10
Monthly Google trend	6,617	41.51	19.48	20.00	100.00

Table A3. Descriptive Statistics for Special Districts (Aug 2014-Apr 2017)

Variable	Obs	Mean	Std. Dev.	Min	Max
Complaint per1000	4,730	0.34	1.34	0.00	47.29
%Monthly water conservation compared to 2013	4,730	19.84	14.28	-108.42	79.23
Municipal	4,730	0.00	0.00	0.00	0.00
Special district	4,730	1.00	0.00	1.00	1.00
Party competition (registered)	4,730	0.75	0.16	0.31	1.00
% State conservation standard	4,730	26.22	8.37	4.00	36.00
Water days allowed per week	4,730	4.11	2.30	0.00	7.00
% Residential use	4,730	72.87	17.04	5.81	100.00
Groundwater	4,730	0.31	0.46	0.00	1.00
Purchased water	4,730	0.40	0.49	0.00	1.00
Drought score	4,730	3.83	1.41	0.00	5.00
Percent turnout	4,730	77.09	7.10	53.74	88.32
Mean-median ratio	4,730	1.27	0.10	1.10	1.68
Population density	4,730	3.84	7.22	0.00	86.45
Ethnic diversity	4,730	0.52	0.13	0.13	0.77
Percent Hispanic	4,730	43.83	25.13	7.77	96.76
Percent Black	4,730	3.24	4.92	0.01	43.59
Percent Asian	4,730	8.43	10.22	0.18	64.16
Percent bachelor	4,730	31.71	14.94	1.86	76.10
Percent poverty	4,730	12.98	5.96	2.50	33.58
Median household income (1000s)	4,730	72.73	23.18	33.19	156.88
Monthly Google trend	4,730	41.51	19.48	20.00	100.00

Table A4. Descriptive Statistics for Private Utilities (Aug 2014-Apr 2017)

Variable	Obs	Mean	Std. Dev.	Min	Max
Complaint per1000	2,046	0.18	0.54	0.00	10.96
% Monthly water conservation compared to 2013	2,046	20.59	11.96	-36.52	64.73
Municipal	2,046	0.00	0.00	0.00	0.00
Special district	2,046	0.00	0.00	0.00	0.00
Party competition (registered)	2,046	0.66	0.23	0.13	1.00
% State conservation standard	2,046	23.10	9.04	8.00	36.00
Water days allowed per week	2,046	3.70	2.09	0.00	7.00
% Residential use	2,046	72.16	13.47	25.00	100.00
Groundwater	2,046	0.35	0.48	0.00	1.00
Purchased water	2,046	0.48	0.50	0.00	1.00
Drought score	2,046	4.06	1.48	0.00	5.00
Percent turnout	2,046	71.63	7.89	52.90	86.93
Mean-median ratio	2,049	1.26	0.08	1.14	1.53
Population density	2,046	7.14	6.03	0.56	33.91
Ethnic diversity	2,049	0.55	0.15	0.13	0.74
Percent Hispanic	2,049	33.92	14.96	7.45	88.22
Percent Black	2,049	5.97	5.25	0.66	30.57
Percent Asian	2,049	18.78	13.46	0.90	53.32
Percent bachelor	2,046	29.65	16.09	4.40	67.02
Percent poverty	2,046	15.42	8.17	4.30	39.00
Median household income (1000s)	2,049	67.45	25.01	23.06	145.42
Monthly Google trend	2,046	41.52	19.50	20.00	100.00